Name: ______________________ Period: __________

Unit 14 Gas Laws Funsheets

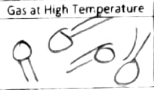
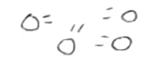
Funsheets 1

Part A: Vocabulary and Concepts- *Answer the following questions. Refer to your notes and the PowerPoint for help.*

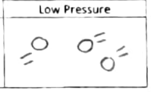
1. List 5 different common uses for gases:
   a. Air bags
   b. tires
   c. ballons
   d. breathing
   e. neon signs
2. Gases have (definite/*indefinite*) shape and (*definite/indefinite*) volume.
3. For each variable below, write what it stands for and the units.
   a. V = volume and has units of L
   b. T = temperature and has units of K
   c. n = amount and has units of moles
   d. P = pressure and has units of atm
   e. R = Universal gas constant and has units of 0.0821 L atm/mol K
4. Summarize the 5 parts of the Kinetic Molecular Theory:
   a. Gases are made of tiny particles
   b. particle size is basically zero
   c. particles are constantly + randomly move, exerting pressure
   d. particles don't attract or repel each other
   e. temperature is equal to the average Kinetic energy
5. Label the following scenarios as describing DIFFUSION or EFFUSION of a gas.
   a. D The smell of freshly baked cookies fills the kitchen and then through the entire house.
   b. E A tire runs over a nail and air slowly leaks out.
   c. E A popped air mattress slowly leaks air.
   d. D When a person lights a match in a room, the room slowly begins to smell of burning.
   e. E A beach ball is punctured and it immediately deflates.
6. STP stands for standard temp + pressure.
7. At STP, the temperature is 273 K, the pressure is 1 atm, and 1 mole of gas occupies 22.4 L space.
8. What is temperature a measure of?
   average Kinetic energy
9. What is absolute zero?
   Ø K
10. What is pressure?
    how often + how hard particles collide with the container
11. What tool is used to measure atmospheric pressure? barometer
12. What is an ideal gas and give a real life example of an ideal gas?
    hypothetical gas the obeys Ideal Gas Law
    None really, but we assume many are anyway (H_2, O_2, etc)

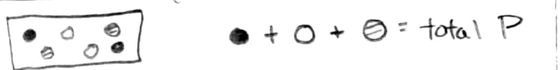
Part B: Modeling- *Model the following in the space provided below. You may NOT use models from the PowerPoint.*

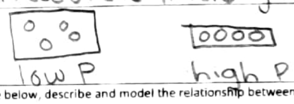
1. In the space below model the difference between a gas at high temperature and a gas at low temperature:

Gas at High Temperature	Gas at Low Temperature
	

2. In the space below model the difference between a high pressure and a low pressure:

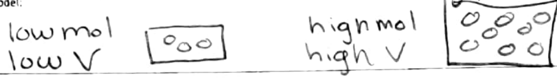
High Pressure	Low Pressure
	

3. In the space below, describe and model Dalton's Law of Partial Pressure:
   Describe: total P equals sum of partial pressures
   Model:
   

4. In the space below, describe and model the relationship between Pressure and Volume. You may not use the picture from the PowerPoint!
   Describe: Pressure is inversely relate to volume
   Model:
   

5. In the space below, describe and model the relationship between Volume and Temperature. You may not use the picture from the PowerPoint!
   Describe: Volume is directly proportional to temp
   Model:
   

6. In the space below, describe and model the relationship between Pressure and Temperature. You may not use the picture from the PowerPoint!
   Describe: Pressure is directly proportional to temp
   Model:
   

7. In the space below, describe and model the relationship between Volume and number of molecules. You may not use the picture from the PowerPoint!
   Describe: Volume and moles are directly proportional
   Model:
   

Part C: Temperature and Pressure Conversions- *Show ALL WORK for credit. Include units in your answer.*

1. Convert the following temperatures to Kelvin:
   a. -90°C = 183 K
   b. 13.1°C = 286.1 K
   c. -55.2°C = 217.8 K
   d. 150°C = 423 K
2. Convert the following temperatures to Celsius:
   a. 567.1 K= 294.1 °C
   b. 275 K= 2 °C
   c. 298 K= 25 °C
   d. 142 K= -131 °C
3. 7.90 atm of pressure= 6004 torr
4. 233 kPa= 2.3 atm
5. 549 mm Hg= 21.6 inches Hg
6. 890 kPa= 6700 torr
7. 39.0 PSI= 2.65 atm
8. 450 kPa= 3400 mm Hg
9. 1230 mm Hg= 1.62 atm
10. 999 torr= 1.31 atm
11. 18.2 PSI= 1.24 atm

Part D: Gas Laws- *Show ALL WORK for credit. Include units in your answer.*

Dalton's Law of Partial Pressures

1. The pressure of a mixture of nitrogen, carbon dioxide, and oxygen is 150 kPa. What is the partial pressure of oxygen if the partial pressures of the nitrogen and carbon dioxide are 100 kPA and 24 kPa, respectively?

   $150 = P_{O_2} + 100 + 24$ $\boxed{P_{O_2} = 26 \text{ KPa}}$

2. A container holds three gases: oxygen, carbon dioxide, and helium. The partial pressures of the three gases are 2.00 atm, 3.00 atm, and 4.00 atm, respectively. What is the total pressure inside the container?

   $P_{total} = 2 + 3 + 4 = \boxed{9 \text{ atm}}$

3. If carbon monoxide and oxygen are in a container and exert a pressure of 760 torr, and the partial pressure of carbon monoxide is 0.98 kPa, what is the partial pressure of oxygen?

   converted to torr

   $760 = 7.34 + PO_2$ $\boxed{P_{O_2} = 752 \text{ torr}}$

4. A metal tank contains three gases: oxygen, helium, and nitrogen. If the partial pressures of the three gases in the tank are 35 atm of O_2, 775 mm Hg of N_2, and 81.0 PSI of He, what is the total pressure inside the tank?

   converted to atm

   $P_{total} = 35 + 1.02 + 5.51 = \boxed{41.53 \text{ atm}}$

5. Blast furnaces give off many unpleasant and unhealthy gases. If the total air pressure is 0.99 atm, the partial pressure of carbon dioxide is 0.05 atm, and the partial pressure of hydrogen sulfide is 0.02 atm, what is the partial pressure of the remaining air?

   $0.99 = 0.05 + 0.02 + P_{air}$

   $\boxed{P_{air} = 0.92 \text{ atm}}$

Boyles Law

6. If 1.00 L of a gas at standard temperature and pressure is compressed to 473 mL, what is the new pressure of the gas?

   convert to L ✓

   $(1)(1.00) = P_2(.473)$ $\boxed{P_2 = 2.11 \text{ atm}}$

7. In a thermonuclear device, the pressure of 0.050 liters of gas within the bomb casing reaches 4.0×10^6 atm. When the bomb casing is destroyed by the explosion, the gas is released into the atmosphere where it reaches a pressure of 1.00 atm. What is the volume of the gas after the explosion?

   $(0.050)(4.0 \times 10^6) = V_2(1.00)$ $\boxed{V_2 = 2.0 \times 10^5 \text{ L}}$

8. Synthetic diamonds can be manufactured at pressures of 6.00×10^4 atm. If we took 2.00 liters of a gas at 1.00 atm, and compressed it to a pressure of 6.00×10^4 atm, what would the volume of the gas be?

   $(2.00)(1.00) = V_2(6.00 \times 10^4)$ $\boxed{V_2 = 3.33 \times 10^{-5} \text{ L}}$

9. The highest pressure ever produced in a laboratory setting was about 2.0×10^6 atm. If we have 1.0×10^{-5} liter sample of gas at that pressure, then release the pressure until it is equal to 0.275 atm, what would the new volume of that gas be?

   $(2.0 \times 10^6)(1.0 \times 10^{-5}) = (0.275)V_2$ $\boxed{V_2 = 73 \text{ L}}$

10. Atmospheric pressure on the peak of Mt. Everest can be as low as 150 mm Hg, which is why climbers need to bring oxygen tanks for the last part of the climb. If the climbers carry 10.0 liter tank with an internal gas pressure of 3.04×10^4 mm Hg, what will be the volume of the gas when it is released from the tanks at the peak?

   $(10.0)(3.04 \times 10^4) = V_2(150)$ $\boxed{V_2 = 2030 \text{ L}}$

$K = 273 + °C$ **Charles's Law** All T in K!

11. The temperature inside my refrigerator is about 4°C. If I place a balloon in my fridge that initially has a temperature of 22°C and a volume of 0.50 liters, what will be the volume of the balloon when it is fully cooled by my refrigerator?

   $.50/295 = V_2/277$ $\boxed{V_2 = .47 \text{ L}}$

12. A man heats a balloon in the oven. If the balloon initially has a volume of 0.40 liters and a temperature of 20°C, what will the volume of the balloon be after he heats it to a temperature of 250°C?

   $.40/293 = V_2/523$ $\boxed{V_2 = .71 \text{ L}}$

13. On a hot day, you may have noticed that potato chip bag seemed to "inflate", even though they have not been opened. If I have a 250mL bag at a temperature of 19°C, and I leave it in my car which has a temperature of 60°C, what will the new volume of the bag be?

   $250/292 = V_2/333$ $\boxed{V_2 = 290 \text{ mL}}$

14. A soda bottle is flexible enough that the volume of the bottle can change without opening it. If you have an empty soda bottle (volume of 2.0 L) at room temperature (25°C), what will the new volume be if you put it in your freezer (-4.0°C)?

   $2.0/298 = V_2/269$ $\boxed{V_2 = 1.8 \text{ L}}$

15. Some students believe that teachers are full of hot air. If I inhale 2.2 liters of gas at a temperature of 18°C and it heats to a temperature of 38°C in my lungs, what is the new volume of the gas?

   $2.2/291 = V_2/311$ $\boxed{V_2 = 2.4 \text{ L}}$

Funsheets 2

All Tink!

Gay-Lussac's Law

K = 273 + °C

16. Determine the pressure change when a constant volume of gas at 1.00 atm is heated from 20.0 °C to 30.0 °C.

$1.00/293 = P_2/303$ **$P_2 = 1.03$ atm**

17. A container of gas is initially at 0.500 atm and 25 °C. What will the pressure be at 125 °C?

$.500/298 = P_2/398$ **$P_2 = 0.668$ atm**

18. A gas container is initially at 47 mm Hg and 77 K (liquid nitrogen temperature.) What will the pressure be when the container warms up to room temperature of 25 °C?

$47/77 = P_2/298$ **$P_2 = 180$ mm Hg**

19. A gas thermometer measures temperature by measuring the pressure of a gas inside the fixed volume container. A thermometer reads a pressure of 248 Torr at 0 °C. What is the temperature when the thermometer reads a pressure of 345 Torr?

$248/273 = 345/T_2$ **$T_2 = 380.$ K**

20. A gas is collected at 22.0 °C and 745.0 mm Hg. When the temperature is changed to 0 °C, what is the resulting pressure?

$745.0/295 = P_2/273$ **$P_2 = 689$ mmHg**

All Tink!

Combined Gas Law

K = 273 + °C

21. A helium balloon with an internal pressure of 1.00 atm and a volume of 4.50 L at 20.0 °C is released. What volume will the balloon occupy at an altitude with the pressure is 0.600 atm and the temperature is -20 °C?

$$\frac{(1.00)(4.50)}{293} = \frac{(.600)V_2}{253}$$ **$V_2 = 6.48$ L**

22. You have a gas at 453 mm Hg with a volume of 700 mL and a temperature of 25 °C, what will the temperature of the gas be, if you change the pressure to 278 mm Hg and a volume of 1200 mL?

$$\frac{(453)(700)}{298} = \frac{(278)(1200)}{T_2}$$ **$T_2 = 300$ K**

23. A sample of gas occupies a volume of 23 L at 740 torr and 16 °C. Determine the volume of the sample at 760 torr and 37 °C.

$$\frac{(23)(740)}{289} = \frac{V_2(760)}{310}$$ **$V_2 = 24$ L**

24. A bubble of helium gas has a volume of 0.650 mL near the bottom of an aquarium where the pressure is 1.54 atm and the temperature is 12 °C. Determine the bubble's volume upon rising near the top where the pressure is 1.01 atm and 16 °C.

$$\frac{(1.54)(.650)}{285} = \frac{(1.01)V_2}{289}$$ **$V_2 = 1.00$ mL**

25. A sample of gas has a volume of 215 cm^3 at 23.5 °C and 84.6 kPa. What volume will the gas occupy at STP?

$$\frac{(84.6)(215)}{296.5} = \frac{(101.5)V_2}{273}$$ **$V_2 = 165\ cm^3$**

Avogadro's Hypothesis

26. A 25.5 liter balloon holding 3.5 moles of carbon dioxide leaks. If we are able to determine that 1.9 moles of carbon dioxide escaped before the container could be sealed, what is the new volume of the container?

$3.5 - 1.9 = 1.6$ $$\frac{25.5}{3.5} = \frac{V_2}{1.6}$$ **$V_2 = 12$ L**

27. If Sample #1 contains 2.98 moles of hydrogen at 35.1 degrees C and 2.3 atm in a 32.8 L container. How many moles of hydrogen are in a 45.3 liter container under the same conditions?

$32.8/2.98 = 45.3/n_2$ **$n_2 = 4.12$ mol**

28. Sally adds 3.13 moles of argon to a 5.29 liter balloon that already contained 2.51 moles of argon. What is the volume of the balloon after the addition of the extra gas?

$2.51 + 3.13 = 5.64$ $5.29/2.51 = V_2/5.64$ **$V_2 = 11.9$ L**

29. If Sample #1 contains 2.3 moles of chlorine gas in a 3.5 liter balloon and at the same conditions Sample #2 contains 1.2 moles of chlorine gas, what is the volume of the balloon that contains Sample #2?

$3.5/2.3 = V_2/1.2$ **$V_2 = 1.8$ L**

30. Pedro adds 1.25 moles of helium to a balloon that already contained 4.51 moles of helium creating a balloon with a volume of 8.97 liters. What was the volume of the balloon before the addition of the extra gas?

$1.25 + 4.51 = 5.76$ mol $8.97/5.76 = V_2/4.51$ **$V_2 = 7.02$ L**

Tink! Pinatm!

Ideal Gas Laws

VinL!

31. If I have 4 moles of gas at a pressure of 5.6 atm and a volume of 12 liters, what is the temperature?

$(5.6)(12) = (4)(.0821)T$ **T = 200 K**

32. If I have an unknown quantity of gas at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 °C, how many moles of gas do I have?

$(1.2)(31) = n(.0821)(360)$ **n = 1.3 mol**

33. If I contain 3 moles of gas in a container with a volume of 60 liters and at a temperature of 400 K, what is the pressure inside the container?

$P(60) = (3)(.0821)(400)$ **P = 2 atm**

34. If I have 7.7 moles of gas at a temperature of 67 °C, and a volume of 88.89 liters, what is the pressure of the gas?

$P(88.89) = (7.7)(.0821)(340)$ **P = 2.4 atm**

35. If I have an unknown quantity of gas at a pressure of 0.5 atm, a volume of 25 liters, and a temperature of 300 K, how many moles of gas do I have?

$(.5)(25) = n(.0821)(300)$

n = 0.5 mol

Tink!

All Gas Laws Mixed Up

Solve each problem and indicate which law was used to solve the problem.

Combined 36. A sample of gas occupies 2.0 L of space at 13 °C and 1.5 atm. How much space will the gas occupy at STP?

$\frac{(1.5)(2.0)}{286} = \frac{(1)V_2}{273}$ $V_2 = 2.9\ L$

Boyle's 37. Divers get "the bends" if they come up too fast because gas in their blood expands, forming bubbles in their blood. If a diver has 0.05 L of gas in his blood under pressure of 250 atm, then rises instantaneously to a depth where his blood has a pressure of 50.0 atm, what will the volume of gas in his blood be?

$(250)(.05) = (50.0)V_2$ $V_2 = 0.3\ L$

Charle's 38. How hot will a 2.3 L balloon have to get to expand to a volume of 400 L? Assume the initial temperature is 25°C.

$2.3/298 = 400/T_2$ $T_2 = 50000\ K$

Gay-Lussac's 39. The air pressure in my tires is about 33 psi on a day with the temperature around 25°C. What will the pressure in my tires be on a cold day with a temperature of 10°C?

$33/298 = P_2/283$ $P_2 = 31\ psi$

Gay-Lussac's 40. A gas has a pressure of 699.0 mm Hg at 40.0 °C. What is the temperature at standard pressure?

$699.0/313 = 760/T_2$ $T_2 = 340\ K$

Charles's 41. I have made a thermometer which measures temperature by compressing and expanding of gas in a piston. I have measured that at 100°C the volume of the piston is 20.0 L. What is the temperature outside if the piston has a volume of 15 L?

$20.0/373 = 15/T_2$ $T_2 = 280\ K$

Ideal 42. If I have 72 liters of gas held at a pressure of 3.4 atm and a temperature of 225 K, how many moles of gas do I have?

$(3.4)(72) = n(.0821)(225)$ $n = 13\ mol$

Avogadro's 43. If I fill a balloon with 5.3 moles of gas and it creates a balloon with a volume of 23.5 liters, how many moles are in a balloon at the same temperature and pressure that has a volume of 14.9 liters?

$23.5/5.3 = 14.9/n_2$ $n_2 = 3.4\ mol$

Ideal 44. If I have 21 moles of gas held at a pressure of 78 atm and a temp of 900 K, what is the volume of the gas?

$(78)V = (21)(.0821)(900)$ $V = 20\ L$

Combined 45. You are playing in the pool during a hot summer day. If you go down to the bottom of the pool where the pressure is 1.50 atm and the temperature is 289 K and you blow an air bubble that is 15 mL. What size will the bubble be when it rises to the top of the pool that has a temperature of 295K and pressure of 1 atm?

$\frac{(1.50)(15)}{289} = \frac{(1)V_2}{295}$ $V_2 = 20\ L$

Dalton's 46. If carbon monoxide and oxygen are in a container and exert a pressure of 1.6 atm, and the partial pressure of carbon monoxide is 0.65 atm, what is the partial pressure of oxygen?

$1.6 = 0.65 + P_{O_2}$ $PO_2 = 0.95\ atm$

Avogadro's 47. If Sample #1 contains 0.70 moles of hydrogen at 5.1 degrees C and 1.3 atm in a 280 mL container. How many moles of hydrogen are in a 500 mL container under the same conditions?

$280/.70 = 500/n_2$ $n_2 = 1\ mol$

Dalton's 48. A container holds three gases: oxygen, carbon dioxide, and helium. The partial pressures of the three gases are 775 torr, 722 torr, and 821 torr, respectively. What is the total pressure inside the container?

$775 + 722 + 821 =$ 2318 torr

Boyle's 49. Submarines need to be extremely strong to withstand the extremely high pressure of water pushing down on them. An experimental research submarine with a volume of 15,000 liters has an internal pressure of 1.2 atm. If the pressure of the ocean breaks the submarine forming a bubble with a pressure of 250 atm pushing on it, how big will that bubble be?

$(1.2)(15000) = (250)V_2$ $V_2 = 72\ L$

Formulas and Conversion Factors

Formula Sheet

K = °C + 273   PV = nRT $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ R= $(0.0821 \frac{L\ atm}{mol\ K})$

Units of pressure @ STP:

= 1 atmosphere

= 760 mm Hg

= 760 torr

= 29.92 inches Hg

= 14.7 pounds/in² (psi)

= 101.3 kPa

= about 34 feet of water!